



NO-FEAR

WP3 Summary on Damage Control Strategies

Background

Haemorrhage is the leading cause of preventable death in trauma patient in the first 24 hours. The lethal Triade (Figure 1) is present in the most severely injured patients and is associated with poor outcomes. Its discovery promoted interest in resuscitation strategies that directly target acidosis, hypothermia and coagulopathy. Modern resuscitation after major haemorrhage therefore incorporates early haemorrhages control, permissive hypotension and early treatment of anticipated coagulopathy with blood products. In the light of this Damage Control Strategies aimed to limit this physiological derangement of trauma patients.

Damage control strategies includes:

- Damage Control Resuscitation (DCR): is a systematic approach to the management of the trauma patient with severe injuries, that starts in the emergency room, including early blood product transfusion, reduced crystalloid fluid administration and permissive hypotension in order to prevent the lethal Triade.
- Damage Control Surgery (DCS): all available technique to obtain a rapid control of haemorrhage and contamination and temporary closure, followed by resuscitation in ICU and subsequent re-look and definitive repair once normal physiology has been restored.

Both works in synergy and in parallel. The goal is to restore normal physiology rather than normal anatomy.

When DCS should be started

Damage control should be initiated in severely injured patients with multisystem trauma, but there are no absolute, evidence-based prediction models of who would benefit.

Parameters as a guideline for instituting damage control:

- Haemodynamically Unstable Patients Non Responsive To Initial Resuscitation Procedure
- $\text{ph} \geq 7.2$
- Serum Bicarbonate Level $\geq 15\text{meq/L}$
- Core Temperature $\geq 34^{\circ}\text{C}$
- Transfusion Volume Of Packed RBCs \geq To 4000ml
- Total Blood Replacement $\geq 5000\text{ml}$
- Total Fluid Replacement $\geq 12000\text{ml}$
- Coagulopathy
- Mass casualty situation

Pre-hospital DCR

- Scoop and run
- Control bleeding source: Tourniquet's, compression, Foley's catheters

- Decrease crystalloid administration

DCR in military setting

In the setting of combat or remote and resource-limited environment, several other concerns affect management decisions. Combat casualty care must take into consideration pre-hospital interventions, location, triage, supply, personnel, transportation, security, and operational conditions specific to theatres of conflict. Of the 4,596 combat deaths reported in COL Brian Eastridge's 2012 review *Death on the Battlefield*, 976 casualties died with injuries that an expert panel classified as potentially survivable, and the vast majority of these deaths—just over 90%—were secondary to uncontrolled haemorrhage. In the light of this DCR in military setting focuses on improving methods to control severe bleeding and to provide sufficient fluids and blood products to stabilize the injured casualty in the pre-hospital setting.

Stages of DCS

STAGE 1: Patient selection

- Hemodynamical instability and hypothermia
- Metabolic instability
- Coagulopathy
- Massive blood transfusion
- Operating time in unstable patient aim < 60 min
- Multiple and complex injuries
- Mass casualties/multiple P1 patients
- Minimal resources

STAGE 2: Operative haemorrhage and contamination control

Pre-operative

- Adequate communication with anesthesia
- Adequate communication with nursing team
- Prepare special instruments: sternotomy, thoracotomy, vascular instrument, vascular trolley, GIA or TIA staples, Harmonic or Ligasure devices
- Order blood and blood products

Prepare theatre

- Warm theatre
- Cell-saving devices
- Prepare hybrid theatre if available

Haemorrhage control

→ 4 quadrant packing

In patient with witness arrest or pre arresting

- Aortic cross clamping: Thoracic or abdominal hiatus
- REBOA or trans-arterial catheterization

Arrest all venous and arterial bleeding

- Arterial bleeding: shunted, ligated, ?repair
- Venous bleeding: packing or ligation

Occlusion of inflow into bleeding organ

→ Pringle in livers

Intra-operative or post-operative catheter-directed embolization

Control of contamination

Multiple visceral and or vascular injuries: “clip and drop”

→ Stapler devices or simple suturing

→ Biliary and genitourinary injuries can be temporized by external drainage: T-tube or ureterostomy

Pancreatic injuries should be widely drained and packed

Temporary abdominal closure

→ bogotá bag

→ negative pressure therapy closure

STAGE 3: Physiological restoration in the ICU

- Restoration of the body temperature
- Optimization of oxygen delivery
- Correction of coagulation
- Physiologic endpoints improvement
- Early identification of complications
- Complete secondary and tertiary survey

STAGE 4: Definitive surgery

Timing

- Injury sustained and pattern of injury
- Early (24-48 hours): vascular shunts, proximal bowel injuries
- Later (48-72 hours): packing for liver injuries once coagulopathy has settled
- Physiological stability
- Adjunctive procedure

Re-look laparotomy

- Planned
- On demand

STAGE 5: Abdominal wall closure

Delayed primary abdominal closure

- Intra-operative findings
- High intra-abdominal pressures

Secondary abdominal closure

- Vacuum assisted closure: KCI-ABThera
- Skin-closure only
- Grafts using Vicryl mesh
- Biological meshes: Human (AlloDerm) or porcine (Permacol)
- Split-thickness skin grafts
- Wittmann patch: Velcro-like sheets that are pressed together to secure closure and peeled apart for abdominal re-entry
- Mesh mediated traction
- Large Hernias: component separation and flap reconstruction

Why it is important to proceed to an attempt at standardizing Damage control (damage control resuscitation and damage control surgery) strategies?

Modern damage control combines principles of Damage control surgery (DCS) and Damage control resuscitation (DCR) to achieve a management strategy in surgical patients suffering from life-threatening metabolic derangements as those present in posttraumatic and major emergency and some mass emergency patients. Even though damage control strategies were first described over 80 years ago, the acquisition of these concepts into routine emergency practice has been very slow in adoption and is still not known and practiced in many realities. Damage control approach when used correctly can improve survival in previously unsalvageable patients; when used incorrectly, it can subject patients to imprudent risk and contribute to morbidity. The impact of standardized protocols existing in the experience from the US have shown a definitive benefit for better survival and shorter hospital stay.

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LETHAL TRIADE

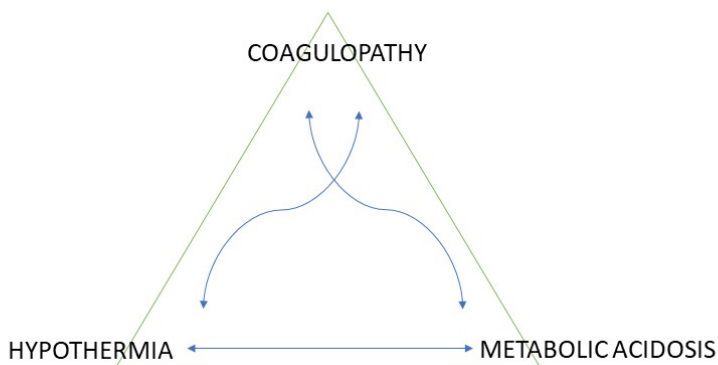


Figure 1: Lethal Triade